

Eastern Washington Agricultural Burning PM2.5 Characterization Project -- Final Report

Short Title:

**Ag Field Burning Particulate Monitoring –
Smoke Net Final Report**

**State of Washington
Department of Ecology
Air Quality Program
Eastern Regional Office (Spokane)
December, 2002**

**This project was funded in whole by a grant (PM 98009401) from
the U.S. Environmental Protection Agency, Region 10**

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I. Introduction

A. Background

Throughout Eastern Washington, some wheat, barley, and alfalfa seed farmers (among others) burn the residue on their fields after harvesting their crops. Field burning is a practice that has taken place for many decades – with varying frequency depending on the weather, growing conditions, and farming practices. Smoke is produced when the residue, often called straw or stubble, is burned. The smoke is a concern for local and regional citizens – especially those sensitive to air pollution. Occasionally, the smoke is dense and causes breathing problems and nuisances for the public. In the late 1990's, field burning in Eastern Washington was on an upswing – the amount of burning was increasing. Citizen concerns and complaints about field burning pollution were also increasing.

The Department of Ecology (Ecology) was deeply involved in the challenging work of carrying out two potentially competing elements of the Washington Clean Air Act.¹ One provision of Washington's air quality law provides for protecting the public's health from air pollution. Another element of our air quality law allows for agricultural field burning. There has been a lot of debate in the last decade over these competing elements of the law. Speculation about the impacts of field burning on local and regional air pollution was rampant. Many of the claims about field burning and smoke could not be substantiated because there was little solid data. The quality of the air in rural Eastern Washington was largely unknown because of the lack of direct measurements

Smoke measurements were limited to the urban areas of Spokane, Yakima, and the Tri-Cities (Kennewick, Richland, Pasco). These urban areas, while often affected by field burning smoke, have a full spectrum of urban air pollution sources. Emissions from sources like woodstoves, vehicle exhaust and industrial emissions complicated the field burning picture. In other words, the air pollution in the big cities did not represent the field burning smoke in rural areas. About the only area of agreement during the raging field burning debate was the desire for more actual air quality measurements closer to the burning.

Ecology set out to establish a network of monitoring locations in rural field burning areas in order to characterize the smoke. (The network of samplers is loosely called the *Smoke-Net* to avoid confusion with other monitoring initiatives.) Ecology's Air Quality Program worked to find funding to install the *Smoke Net*. During the fall of 2000, Ecology sought funding from the U.S. Environmental Protection Agency (EPA). The EPA's Region 10 Office in Seattle awarded Ecology approximately \$ 203,000 to collect smoke pollution

¹ The Washington Clean Air Act is codified as Chapter 70.94 of the Revised Code of Washington. The section of this law that most directly addresses field burning is RCW 70.94.650.

(fine particulate, PM2.5) data in Eastern Washington during 2001 and the first half of 2002.

B. Purpose

This report explains: how Ecology collected fine particulate (i.e., smoke) monitoring data in three communities in rural south-eastern Washington; how the information was used to characterize field burning impacts on air quality; and, how air quality values were used by Ecology to manage field burning.

C. Overview of Report

TITLE: Eastern Washington Agricultural Burning PM2.5 Characterization Project -- Final Report

SHORT TITLE: Ag Field Burning Particulate Monitoring -- *Smoke Net* Final Report

AUTHOR: State of Washington, Department of Ecology, Air Quality Program, Eastern Regional Office (Spokane)

SUBJECT: Collecting air pollution data from agricultural field burning in three rural southeastern Washington communities and using that information to 1.) characterize the impact of burning on air quality and 2.) manage field burning to minimize adverse impacts from the smoke.

DATE: December, 2002

PURPOSE: Serve as final report on a grant funded project

OUTLINE:

- I. Introduction – Background and Purpose of the Project
- II. Collecting Data – the what, where, & when of monitoring
- III. Data Handling – ensuring quality data and interpretation
- IV. Information Usage – evaluations and decisions based on the data collected
- V. Evaluation – Discussing the success of the project relative to objectives and future potential
- VI. Appendices – Related supporting materials and samples

CONCLUSION: Ecology successfully established three PM2.5 monitoring sites, collected data and used the resulting information in characterizing field burning smoke impacts and in making daily decisions allowing and/or limiting burning.

D. Acknowledgements

The Spokane Office of Department of Ecology's Air Quality Program expresses its sincere thanks to:

- ❖ The U.S. Environmental Protection Agency's Region 10 Office in Seattle (especially Mr. Dave Debruyne and Mr. Scott Downey): for significant financial support, technical and policy support and keen interest.
- ❖ The staff and management of the Department of Ecology's Air Quality Program Headquarters' Office in Lacey, especially:
 - Ms. Kay Journey for administrative and financial support;
 - Mr. Mike Ragan for monitoring technical support;
 - Mr. Stan Rauh and Mr. Sean Lundblad for quality assurance support;
 - Ms. Joan Kiely for telemetry support;
 - Ms. Katherine Scott for contracting support;
 - Ms. Kathy Sundberg for IT support;
 - Ms. Jenny Parikh for analytical support; and,
 - Ms. Judy Beitel & Mr. Bruce Estus for internet support.
- ❖ The City of Pullman for graciously allowing the placement of equipment on their property and for allowing Ecology access to maintain the equipment.
- ❖ The Adams County maintenance shop for graciously allowing the placement of equipment on their property and for allowing Ecology access to maintain the equipment.
- ❖ The Walla Walla Fire Department for graciously allowing the placement of equipment on their property and for allowing Ecology access to maintain the equipment.
- ❖ Mr. Jorge Rodrigo Jimenez, M.S. in the Washington State University Program in Environmental Sciences and Regional Planning: for use of the data in his Master's thesis.
- ❖ Dr. Candis Claiborn, Ph.D., of the Washington State University Department of Civil and Environmental Engineering: for use of the data in her evaluation of air quality impacts from burning.

II. Collecting Fine Particulate Data

The emphasis of this project was two-fold: The primary objective was the collection of ambient air quality data in rural south-eastern Washington. The secondary objective was using the data in burning program decisions and evaluations.

A. Where data were collected:

Levels of air contaminant emission concentrations were measured at three locations as part of this project. The locations were:

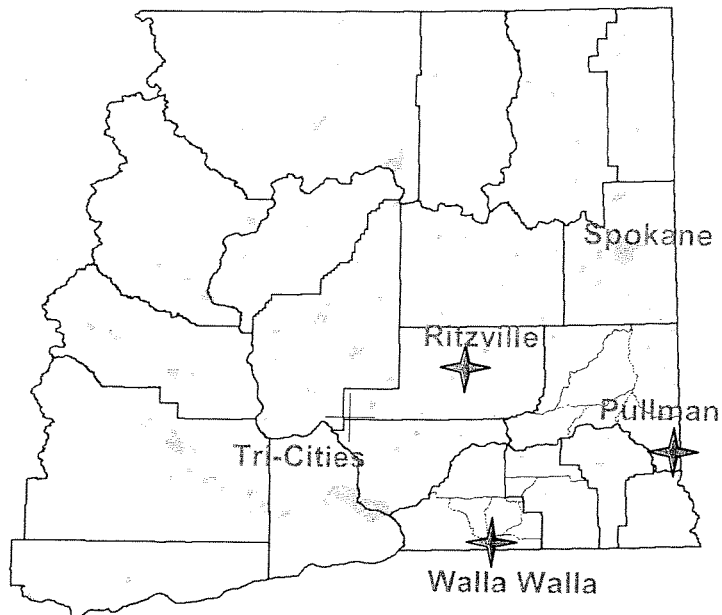
Project Monitoring Locations

<u>Community</u>	<u>County</u>	<u>Site</u>	<u>Address</u>
Pullman	Whitman	Pioneer Place	240 S.E. Dexter
Ritzville	Adams	County Shop	109 W. Alder
Walla Walla	Walla Walla	Fire Station	200 S. 12 th

These locations were selected because they were populated areas, in farm country, where field burning was commonplace.² The specific locations of the monitoring met the site criteria prescribed in 40 CFR Ch 1 Pt. 58, Appendix E.

² Population centers in the Southeast quadrant of Washington are shown in Appendix F (Figure 1.2 on page 5). Wheat production in Southeastern Washington is shown in Appendix A (Figure 1 on page 4). The distribution of field burning by County is detailed in Appendix H – along with a map showing county names.

Monitoring Locations



Photographs of the Pullman and Walla Walla monitoring locations may be viewed on Ecology's Internet web site (<http://airr.ecy.wa.gov/Public/visitasite.shtml>).

B. What data were collected:

This project set out to measure smoke pollution from field burning. Smoke is not a simple compound, but is a complex mixture of compounds. The most direct measurement of smoke is the measurement of fine particulate matter – which consists of very small bits and pieces of solids and liquids that are “floating around” in the air. A tremendous variety of different chemical compounds and mixtures can make up the *suite* of particulate matter. This project sampled (measured) fine particulate of very small sizes. Specifically fine particulates with aerodynamic diameters of 2.5 microns or less were the air pollution of interest in this monitoring project. The commonly used name for this kind of material is: PM_{2.5} (read P-M-two-point-five). The amount of fine particulate matter (PM_{2.5}) in the air was measured at each of the three sites.

C. How data were gathered:

PM2.5 data were collected two ways. The most direct way was by filtering the particles out of the air and weighing the amount of material collected. This technique generates a measurement of the concentration of the pollution in the air. The concentration is the weight (really the mass) of the particles in the volume of air that was filtered. The detailed steps in this basic approach are known as the Federal Reference Method (FRM) for PM2.5. The Federal Reference Methods for particulates (PM2.5) is a manual method that is similar to a vacuum cleaner that draws outside air first through an inlet that removes particulates larger than 2.5 micrometers and then through a filter that collects the remaining particulate matter (PM2.5). Sampling for a single measurement continues for 24 hours from midnight-to-midnight. For each sampling day, when the sampling was completed, the pre-weighed, sampled filter was manually removed and sent to the lab for analysis. Following conditioning in a controlled environment for 24 hours to remove moisture effects, the sampled filter was weighed again on a precision balance and the weight of particulate matter collected during the sample period was calculated. The volume of air sampled was calculated from the flow rate and sampling time. The ambient PM2.5 concentration was calculated by dividing the weight (mass) of collected particulate by the volume of air sampled.

The concentration is reported in micrograms per cubic meter. The final result is a number representing the concentration of PM2.5 for that specific place and specific day. This entire process was repeated every six days at each of the three sites. The time period for the data collection portion of this project began in January, 2001 and continued through June, 2002. The following table summarizes the amount of data collected using the direct, FRM technique – along with basic descriptive statistics about the data as a group.

PM2.5 Monitoring Data using Federal Reference Method (FRM) – collected every 6th day³. (24 hour concentrations are micrograms per cubic meter.)

<u>Feature</u>	<u>Pullman</u>	<u>Ritzville</u>	<u>Walla Walla</u>
Beginning date	January 1, 2001	January 1, 2001	April 1, 2001
Ending date	June 25, 2002	June 25, 2002	April 26, 2002
Number of days monitored using the FRM	89	85	62
Maximum 24 hr concentration measured	13.3	14.0	22.0
Average of the measured concentrations	5.0	5.8	7.1
Standard Deviation of the measured concentrations	2.3	2.8	4.7

A second, indirect method of measuring PM2.5 was employed at each of the three sites. This continuous method (so-called because data are generated every hour for every day) is based on the visibility impairment caused primarily by fine particles (0.1 - 2.5 microns in diameter). Particles these sizes either scatter or absorb light. Sulfates, nitrates, and elemental and organic carbon are most effective at scattering or absorbing light. Human-caused sources of these particles include: wood-burning; emissions from cars, trucks, and buses; smoke/soot from burning fields; and other types of burning. Air quality is also degraded by secondary aerosols – a gaseous suspension of tiny particles and liquid droplets that are formed by chemical reactions.

An electronic instrument, called a Nephelometer, measured the light scattering caused by the fine particulates in the ambient air. The light scattering values for each hour and each day were converted to PM2.5 values using a mathematical relationship. The combination of these two monitoring methods produced a data set of hourly PM2.5 concentrations at each of the three sites for the project period. The following table summarizes the amount

³ A list of each of the daily PM2.5 values, using the FRM, is included for each site in Appendix D.

of data collected using the indirect, light scattering technique – along with basic descriptive statistics about the data as a group.

PM2.5 Data calculated from Nephelometer data – collected continuously⁴ (hourly calculated concentrations as micrograms per cubic meter.)

<u>Feature</u>	<u>Pullman</u>	<u>Ritzville</u>	<u>Walla Walla</u>
Beginning hour	Midnight to One AM on January 1, 2001	Midnight to One AM on January 1, 2001	Five to Six PM on March 2, 2001
Ending hour	Eleven PM to Midnight on June 30, 2002	Eleven PM to Midnight on June 30, 2002	Eleven PM to Midnight on June 30, 2002
Number of hours for which data were collected and PM2.5 values were calculated	13,061	13,057	11,610
Maximum hourly calculated concentration	66.2	73.4	51.9
Average of the calculated concentrations	5.2	5.3	7.1
Standard Deviation of the calculated concentrations	2.9	3.1	5.8

The PM2.5 network design, sample set-up, and collection was performed in accordance with the requirements set forth in 40 CFR 58, Appendix D, "Network Design for State and

⁴ Only a sample page (for each site) of the hourly Nephelometer data is included in Appendix D because a printed table of the data sets would exceed 1000 pages. The entire data set is included on the compact disk as part of Appendix D.

Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS)" and Appendix E, "Probe Siting Criteria for Ambient Air Quality Monitoring" and the "Air Quality Program's Quality Assurance Policy and Procedure Manual".

D. Equipment that was used --

Each of the monitoring sites was equipped with a manual method Rupprecht & Patashnick 2000 Single Channel PM2.5 Sampler (R&P 2000) and with a collocated continuous Radiance Research Nephelometer. Each location also had the electronic gear necessary to store and transmit the data to the Department of Ecology's Headquarters' Offices in Lacey. This suite of equipment is known as the "Telemetry System" and includes data loggers, modems, communication (phone) lines, storage units, processors, and other hardware and software.

E. Procedures that were followed --

The R&P 2000 samplers operated on a 1/6 schedule (sampling every 6th day). The mass of PM2.5 was determined using gravimetric analysis at Ecology's Manchester Laboratory. This manual method PM2.5 data were correlated with the Nephelometer data for the identical time periods (days). The correlation produced a mathematical equation for determining the PM2.5 for time periods when the FRM method was not used. The specific procedures are outlined in the attached Quality Assurance Plan.

III. Handling the Data

A. Quality Assurance

The Quality Assurance Plan for this project is included in Appendix B.

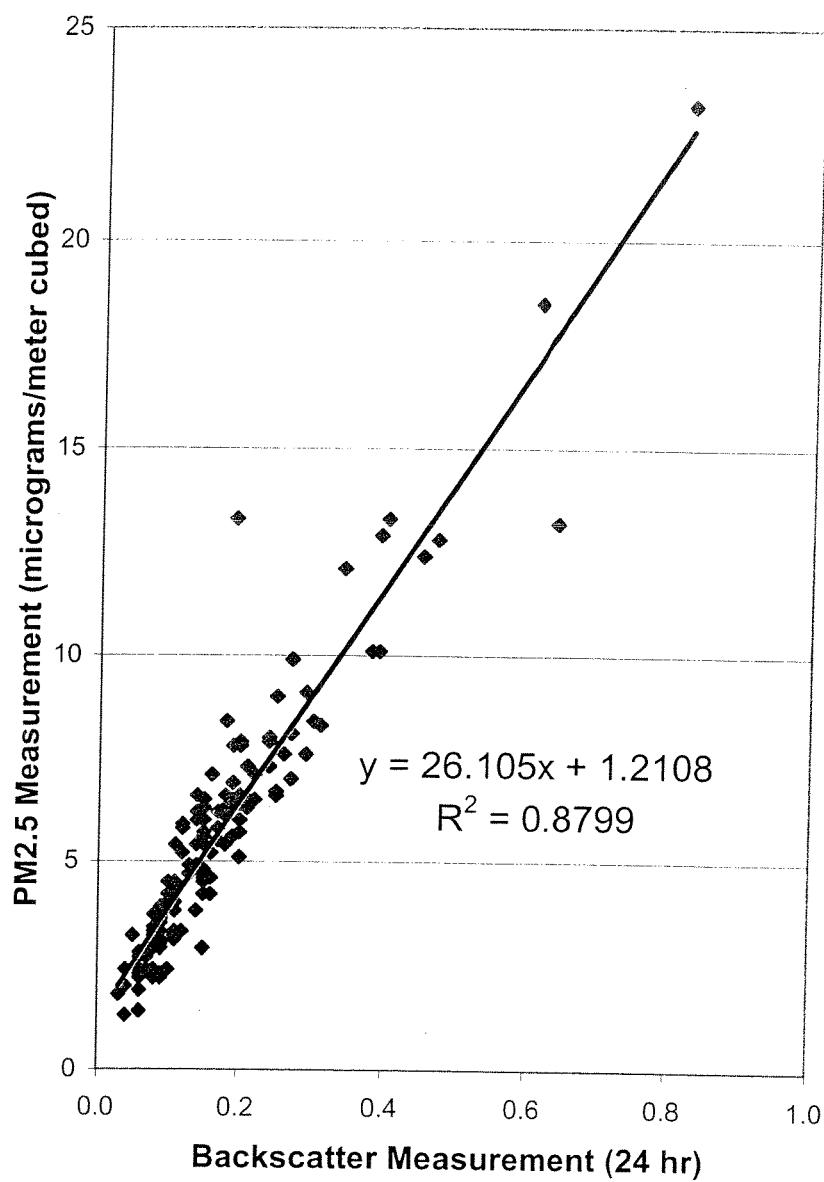
B. Relating the Methods

This project produced two sets of data for each of the three communities. The FRM data were compared to the Nephelometer data by a mathematical relationship. Having a relationship between the continuous method and the FRM method meant that Ecology (and others) was able to predict PM2.5 concentrations based on the continuous

nephelometer readings. This meant that one could, with reasonable certainty, know the level of smoke pollution at each of the sites almost instantaneously. The next section of this report tells how this "near-real-time" information was valuable.

Initially, the two data sets were related through a linear regression analysis. This type of analysis is based on the premise that the greater the PM2.5 concentration in the ambient air, the more light will be scattered (and measured by the nephelometer). The plot of PM2.5 against light scattering for Pullman is shown on the next page.

PULLMAN SITE



The linear regression equation relating the two data sets for Pullman⁵ is:

$$PM2.5 = 26.105*(Bscat)+1.2108 \quad (1)$$

Where:

- PM2.5** = The calculated fine particulate matter concentration for a specific day – as micrograms per cubic meter
- Bscat** = The measured backscattering value of the material in the air during a specific day.
- 26.105 = A constant that is the slope of the line representing the relationship between the two variables: PM2.5 and Bscat.
- 1.2108 = The y-axis intercept of the line representing the relationship between the two variables: PM2.5 and Bscat -- a constant that equals the calculated PM2.5 level if Bscat = zero.

Separate from this project, Ecology conducted a more sophisticated statistical evaluation of the data sets. The evaluation followed procedures developed by the US EPA for relating these kinds of data. The outcome of this analysis, for each site, is the relationship shown in equation # 2.

$$PM2.5 = POWER(10,(LOG(Bscat)*0.710771+1.325303)) \quad (2)$$

Where:

- PM2.5** = The calculated fine particulate matter concentration for a specific hour or day – as micrograms per cubic meter
- Bscat** = The measured backscattering value of the material in the air during a specific hour or averaged over a day.

This (equation #2) is the relationship that is being used today.

⁵ Each point represents a 24 hour value of PM2.5 and backscatter measurement for the Pullman site. The time period is January 2001 through June 2002 – specific dates are listed in Appendix D.

IV. How Information Was Used

A. In Managing Burning

The data made available through this project were used by air quality program staff when making daily burn decisions. The daily burn decision is made using many different sources of information including: meteorology, ventilation forecast, wind direction, and current air quality conditions. (The procedures for making decisions about when, where and how much burning would be allowed are included in Appendix E.) An important element in limiting or allowing field burning is the current level of air pollution in the immediate and downwind areas. The data generated by this project provided measurements of particulate air quality. Before the PM_{2.5} monitoring sites were installed and collecting data, little consideration could be given to existing air quality conditions – because of this lack of monitoring. With the availability of PM_{2.5} monitors in “Wheat Country,” air quality conditions are now considered everyday to insure burning will not exasperate any existing problems. Though no standard was defined at which burning would be curtailed, rising PM readings at the monitors often led to a more restrictive (i.e., less burning) decision on any given day. The real-time data were also extremely beneficial in checking the previous day’s burn decisions. For example, if it was called a burn day and the monitors showed increased values- it probably should have been a more restrictive call.

The air quality data also confirmed the adequate dispersal of emissions when burning and ventilation were high. The actual air quality measurements provided a “reality check” of the predicted dispersion. Confidence in allowing burning was enhanced by the ability to check that certain weather patterns would handle certain levels of burning. Knowing when to allow burning – along with when not to allow it – led to greater effectiveness in carrying out Washington’s Clean Air Act.⁶ The overall result has been the reduction of adverse air quality impacts from field burning – while still allowing burning to take place.

B. In Evaluating Impacts

Daily Evaluations: Ecology was able to evaluate air quality impacts (and confirm the lack of impacts) from many different emission and dispersion conditions because of the project’s monitoring data. This contemporaneous evaluation of air quality levels was blended with dispersion forecasts and emission estimates to make daily decisions to manage burning.

⁶ For a brief discussion of the two competing elements (maintaining clean air & allowing ag burning) in the law – see page 3.

Seasonal Evaluations: The monitoring conducted through this project produced two data sets for each of the three monitoring locations (Pullman, Ritzville, Walla Walla). In addition to the daily evaluations made as part of the burn /no-burn decision process, these data were used in retrospective evaluations.

A Washington State University (WSU) Masters' candidate⁷ and his faculty advisor⁸ used the data gathered through this project in their evaluations of the air quality impacts of agricultural field burning. Appendix F of this report includes a complete copy of the Master's thesis document (*Air Quality Impact from Agricultural Field Burning in Eastern Washington*, Jimenez, J.R., Wash. St. Univ., Aug. 2002). Appendix G of this report is a copy of a summary of this evaluation of air quality impacts from field burning.

In the summer of 2002, Ecology brought together experts on air quality impacts of field burning to review Ecology's agricultural burning program -- especially making the burn / no-burn decision (referred to as the "burn call"). This Expert Panel review was the outcome of a settlement of an action before the U.S. Ninth Circuit Court of Appeals. The litigation and resulting settlement was over the adverse air quality impacts of agricultural field burning. The Expert Panel used the data generated by this project in its review. Copies of the CD in Appendix D of this report were provided to the Expert Panel members. The CD includes all of the data (hourly) for this project as well as additional related data. The Expert Panel recommended improvements to Ecology, which were implemented for the fall 2002 field burning season. Additional recommendations are expected prior to the spring 2003 field burning season.

Much of the data was (and continues to be) made available to anyone interested (see below). Undoubtedly, individuals -- including farmers, scientists, citizens, students -- were watching the air quality and qualitatively evaluating the effects of burning on localized pollution levels.

⁷ Mr. Jorge Rodrigo Jimenez, M.S. -- Washington State University -- Program in Environmental Sciences and Regional Planning.

⁸ Dr. Candis Claiborn, Ph.D., Washington State University, Department of Civil and Environmental Engineering.

C. To Inform the Public

Education and outreach efforts have long been an integral part of the agricultural burn program. The addition of the "smoke net" monitoring network has given Ecology staff a tremendous new tool for use in teaching the public, farmers and activist groups about local air quality. We now have a quantifiable means for showing the public how our air quality could be adversely impacted by various types of burning, be it agricultural field burning, burning in neighboring states, or silvacultural burning. Due to the locating of these PM2.5 monitors in small communities, we also have the ability to see the effects of woodstove emissions and outdoor residential burning on air quality as well. The monitoring data, accessible through telemetry, is made available on Ecology's website to the general public thus making it easier for individuals with home computers to understand their local air quality and its effect on their lives.

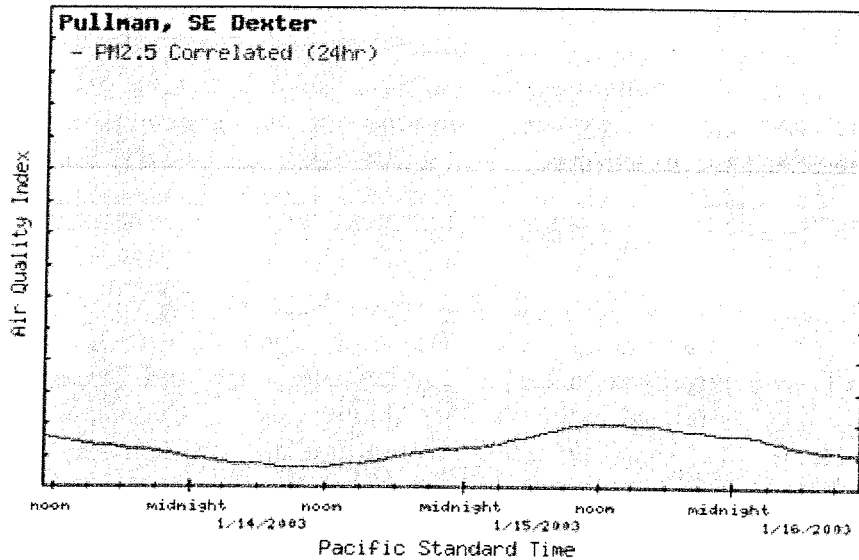
Ecology recently launched a new agricultural and outdoor burn website which has links to and explanations of this monitoring effort. The monitoring website is very user friendly with PM 2.5 data portrayed in easy to understand graph and "speedometer" formats depicting the data as related to EPA's "Air Quality Index". Concerned citizens can now track their local "real time" air quality conditions and growers can begin to understand why the daily burn call is less or more restrictive than the day before when the decision is based largely on existing air quality.

Public notification of whether or not agricultural burning is allowed on any given day and forecasting the possibility of burning for the next day has become a key component of the burn team's outreach efforts. The monitors or "smoke net" play a vital role in the burn team's forecast decisions. Elevated monitoring readings can substantially reduce the amount of acreage burned.

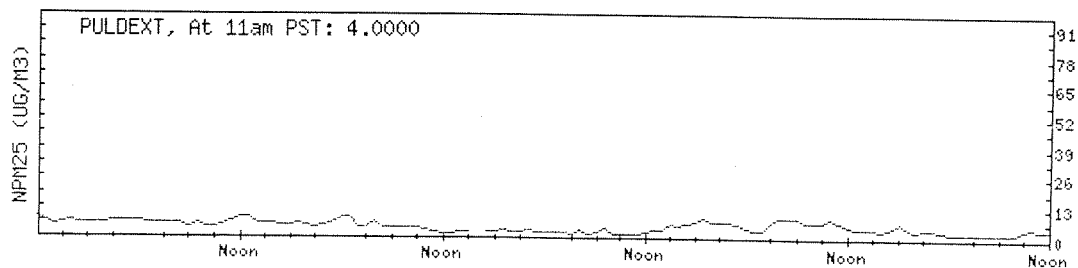
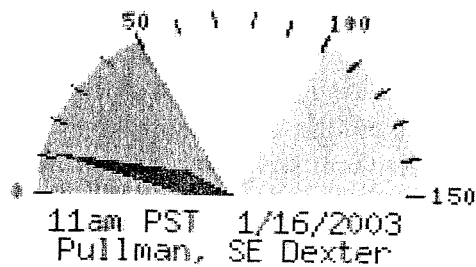
During the fall of 2002 Ecology entered into an agreement with two Eastern Washington TV Stations to provide an agricultural burn forecast during the weather segment of the morning and evening news. This notification avenue was designed to provide information to the general public about when and where burning might be occurring in Washington state for the next day and to direct them to the website where they could access the actual burn decision and the air quality information from the 2.5 monitors. With the use of television we have the ability to reach over 500,000 people through out Eastern Washington, Idaho, and Oregon with this important data. This TV forecast will continue at least through the spring 2003 burn season.

The public can view the monitors and see the effects of inversions, forest fires and other weather related activities and how they affect air quality. Farmers, activist groups, students, and the general public can all view and track the effects of field burning on local particulate matter pollution levels. Following is a sample of a couple of the ways the monitoring data is portrayed on Ecology's website, <http://airr.ecy.wa.gov/Public/aqn.shtml>.

Internet Displays of Monitoring Data
(Available to the general public)



PM2.5 Correlated (24hr)
3.292 ug/m3



V. Evaluating the Project

A. *Meeting Objectives*

The proposal for this project (Appendix A) included 20 objectives and tasks. The following checklist shows those objectives and tasks and indicates that all have been completed.

The checklist also shows that many of the tasks are continuing because the collection of PM data continues in Pullman, Ritzville, and Walla Walla. In each of these communities, a nephelometer measures the air quality on a continuous basis. The measurements are relayed to a central computer via Ecology's Telemetry Network. The measured values of light scattering are converted to hourly PM_{2.5} values using the statistical relationship mentioned in section III-B. These steps are all automated so the outcome is that air pollution levels are continuously reported in a "near-real-time"⁹ manner on Ecology's air quality web site. Finally, the data continue to be used in daily decisions for managing burning and other ongoing uses of the information (see following section).

⁹ Typically, there may be as much as a 1 to 2 hour delay in viewing the hourly data. This delay is the result of reporting readings for clock-hour-averages and the time to post values to the web site.

Project Proposal Checklist

<u>Objective / Task (see Appendix A)</u>	<u>DONE</u>	<u>Ongoing Activity</u>	<u>notes</u>
Enhance the existing PM2.5 monitoring network in Eastern Washington	✓	✓	
Establish (locate, site, maintain) three PM2.5 stations	✓	✓	
Pullman	✓	✓	
Ritzville	✓	✓	
Walla Walla	✓	✓	
Use data to characterize agricultural burning impacts within these communities	✓	✓	See IV-B
Continue monitoring through June 30, 2002	✓	✓	Ongoing
Develop a Quality Assurance Plan for the project	✓		See III-A & Appendix B
Equip the sites with FRM gear and Nephelometers	✓		See II-D
Collect FRM samples on a 1 day in 6 schedule	✓		
Operate Nephelometers continuously ("real-time")	✓	✓	
Build a correlation between FRM and Nephelometer data sets	✓		See III-B & Appendix D
Make continuous data available through telemetry	✓	✓	See VI-C
Co-locate and operate a second FRM at Pullman for precision evaluations	✓		
Adhere to siting criteria in 40 CFR	✓	✓	See II
Operate consistent with standard protocols	✓	✓	See II
Include independent Quality Assurance checks	✓	✓	See III-A
Integrate use of the monitoring data into Ecology's ag burning permitting program	✓	✓	See IV-A
Use data in development of improved permitting tools	✓	✓	See IV-B
Make data available to others for evaluating PM2.5	✓	✓	See IV-B, C

B. Shaping the Future

Ecology has been able to place more monitors within the stubble burning region of Eastern Washington at a substantially reduced cost due to the correlation factor derived from data collected from the three sites during the duration of this project. With the added sites the "smoke-net" monitoring effort now includes ten PM 2.5 monitors scattered in and around the wheat stubble burning areas of Eastern Washington. Neighboring states and the US Forest Service (USFS) have been noting the practicality and need for this type of relatively inexpensive smoke monitoring and are exploring ways to expand the coverage into areas that they regulate. The USFS recently added several PM 2.5 Nephelometers along the east slopes of the Cascades where smoke from silva cultural burning often impacts communities. Ecology entered into an agreement with the USFS to include the data generated from these new monitors on our public accessible webpage as well. Having data available from the monitoring network also helps in modeling the source of smoke impacts through back-trajectories.

The public and Ecology can, through use of this monitoring data, evaluate how stagnant weather conditions affect local air quality during times of severe weather inversions. Ecology has used this data as a decision making tool for determining when to communicate to the public about possible health advisories related to elevated pollution levels and to ask people to voluntarily restrict their woodstove and outdoor burning activities during long-term stagnant weather systems.

Future outreach efforts could include the continuation of television field burning forecasts though this will depend on available funding. The field burning forecasts direct viewers to the website where the data from monitors can be viewed. With the use of television we have the ability to reach over 500,000 people through out Eastern Washington, Idaho, and Oregon with this important data. The monitors will continue to be a major portion of the agricultural and outdoor burn websites. Other outreach efforts that are planned to spread the word about air quality and monitoring are farmer groups and schools within our region since a number of the monitors are located on school buildings.

Beginning in 2001, a "Post Burn" report was required for all permitted agricultural burns. These reports help Ecology's "Burn Team" to know, by location, how many acres were burned on any given day. By correlating monitoring data with information retrieved from these post burn reports we are able to determine ambient impacts, if any, of these field burns on monitor locations. These two pieces of information, monitoring data and post burn reporting, are critical in any limiting of acres available to be burned on any given day (metering) or modeling efforts conducted. As we continue to learn more and utilize the metering approach to approving burning, the burn team must rely more and more on the information the monitors provide.

Ecology is currently funding the development of a local smoke dispersion model, ClearSky, by Washington State University and is involved in the "BlueSky" smoke

modeling effort being developed by the US Forest Service for which accurate, timely PM 2.5 data is paramount. A GIS system for tracking permitted and burned acres is already in the development stages and again requires a monitoring site data layer. Having data available from the monitoring network also helps us in modeling the source of smoke impacts through back-trajectories.

The data collected by this monitoring network is currently being used in scientific research conducted by Washington State University and the University of Washington. A health assessment of field burning effects on sensitive individuals is now underway and data collected by the Pullman monitor is a critical piece of the research. We are confident that the monitors will continue to play an important role in the future both for PM exposure research and toxic air pollutant evaluative work that the agency is now undertaking.

In 2004, Ecology will commence rule making efforts to revise the rules that govern how field burning will take place. The data collected from the PM2.5 monitors will play a substantial role in deciding what affects field burning has on our air quality in Eastern Washington and how best to integrate that data into our decision making processes.

VI. APPENDICES

- | | |
|----------|---|
| A | Project Proposal |
| B | Quality Assurance Plan |
| C | Quality Assurance Assessment |
| D | Data Samples |
| E | Daily Burn / No-burn Decisions |
| F | Evaluation of Impacts – Masters Thesis |
| G | Independent Evaluation Summary (WSU) |
| H | Agricultural Burning Summary |

The title page for each Appendix follows:

APPENDIX A

Project Proposal

This is the proposal to the U.S. EPA which sought funding for the establishment of three particulate air pollution monitoring sites in rural south-eastern Washington.

Size 4 pages

Date October 9, 2000

Principal Author Kenneth A. Gamble
State of Washington, Department of Ecology, Air Quality
Program, Eastern Regional Office (Spokane)

APPENDIX B

Quality Assurance Plan

This is the specific plan for this project which spelled out how to conduct the study so that quality data would be collected.

Size 22 pages

Date January, 2001

Principal Authors Stan Rauh
State of Washington, Department of Ecology, Air Quality
Program, Headquarters' Office (Lacey)

Greg Hannahs
State of Washington, Department of Ecology, Air Quality
Program, Eastern Regional Office (Spokane)

APPENDIX C

Quality Assurance Assessment

The following documents describe the results of quarterly and annual assessments of air quality monitoring data in Washington. The reports contain information about the three that were a part of this project.

The sites are identified in the reports as:

<u>Community</u>	<u>Name</u>
Pullman	Pioneer Place
Ritzville	County Shop
Walla Walla	Fire Station

Sizes 16, 18, 20, 18,20, & 18 pages

Dates 2001 & 2002

Principal Authors Stan Rauh
State of Washington, Department of Ecology, Air Quality
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Sean Lundblad
State of Washington, Department of Ecology, Air Quality
Program, Headquarters' Office (Lacey)

APPENDIX C

Quality Assurance Assessment

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APPENDIX C

Quality Assurance Assessment

The 2nd *Quarter Air Monitoring Data Quality Assessment Report* was not available at the time of publishing this final report. Once completed, it will be available from the Department of Ecology upon request.

APPENDIX D

Data Samples

The following charts and tables are representative of the ambient air quality data that were collected through this project. Only a sample is included because a printed copy of all the data would require approximately one thousand pages.

A complete set of data collected through this project is available upon request from the Department of Ecology.

Size 32 pages

Date December, 2002

Principal Authors John Poffenroth,
Greg Hannahs
Neil Hodgson
State of Washington, Department of Ecology, Air Quality
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- ***Data Samples -- Pullman***

The following charts and tables are representative of the ambient air quality data that were collected through this project.

A complete set of data collected through this project is available upon request from the Department of Ecology.

- ***Data Samples -- Ritzville***

The following charts and tables are representative of the ambient air quality data that were collected through this project.

A complete set of data collected through this project is available upon request from the Department of Ecology.

- ***Data Samples -- Walla Walla***

The following charts and tables are representative of the ambient air quality data that were collected through this project.

A complete set of data collected through this project is available upon request from the Department of Ecology.

APPENDIX E

Daily Burn / No-burn Decisions

This Appendix includes the procedures for determining, on a daily basis: where, when and how much agricultural field burning will be allowed – if any. The determination takes into consideration the ambient air quality levels reported by the *Smoke Net*.

Also included is a copy of the notes made as part of making the daily “burn-call” for October 15, 2002.

Additional notes are available from Ecology on request.

Size 4 pages & 30 pages

Date August 7, 2002 & October 15, 2002

Principal Authors Karen K. Wood
Sara Johnson
State of Washington, Department of Ecology, Air Quality
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APPENDIX F

Evaluation of Impacts – Masters Thesis

The following document used PM2.5 air quality data generated through this project. The data sets are described in the document beginning on page 30, in section 3.3.1.

One of the objectives of this project was making data available for evaluations such as this one.

Size 180 pages (including appendices)

Date August 2002

Principal Author Mr. Jorge Rodrigo Jimenez, M.S.
Washington State University
Program in Environmental Sciences and Regional Planning

APPENDIX G

Independent Evaluation Summary (WSU)

The following document used PM2.5 air quality data generated through this project. The data are described in the document beginning on page 4.

One of the objectives of this project was making data available for evaluations such as this one.

Size 12 pages

Date September 4, 2002

Principal Author Dr. Candis Claiborn, Ph.D.
Washington State University
Department of Civil and Environmental Engineering

APPENDIX H

Agricultural Burning Summary

This Appendix includes three documents:

1. A summary table of agricultural burning in Washington for the past several years. The most recent data (fall 2002) is draft and subject to change at the time of publication of this report.
2. A Washington map showing counties and air quality jurisdictions.
3. A map of Eastern Washington Agricultural burning in 2000. Despite the poor quality (due to scaling the diagram to fit this report), the diagram indicates where burning is most concentrated.

Size 3 pages

Date December 18, 2002

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